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# Trends of Social Welfare Systems : From Convergence to Attractiveness, an Exploratory Approach

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**Trends of Social Welfare Systems: From Convergence to Attractiveness, an Exploratory Approach**[1]

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Each country has its own history of welfare state but generally within a common system of values and finality: a peaceful society and a 'good society' based on universal values. After the Second World War, during the golden age, the differences between the levels of social welfare were often conceived as a lag effect, more or less in a similar way to the notion of takeoff in economic development. This was analysed as a kind of laggardness which could be offset over time by extending social rights. Finally, all the most developed countries were supposed to participate in an upward convergence of social welfare systems.

Convergence in the social welfare systems of the most developed countries has been very often analysed in a large number of papers and books. These studies show that the idea of convergence is present in all social domains. It is obvious that part of the convergence of the most developed social welfare systems results from the construction of Europe. However, the principle of subsidiarity means that national welfare systems remain partly autonomous in front of European harmonisation.

This paper is based on another source of convergence, i.e., the reforms which are inspired by other national systems or reforms. In many European countries, these reforms have mainly been 'home grown'. Major reform initiatives are formulated by senior civil servants (Saari, 2001: 138) who take into account foreign rules, policies or experiments and adapt them in their home countries. It is possible to transplant certain foreign experiences *within* a national system which often lead to a hybridisation of the systems (Zeitlin & Herrigel 1999, Zeitlin & Trubek, 2003). Many examples were provided in the papers of the ESPAnet Conference in Helsinki, in September 2008, on the subject entitled ' *Cross-border Influences in Social Policy'*. Hinrichs (2002) perfectly summarises the objective of my paper, by the title of an article: *What can be learned from whom? Germany's employment problem in comparative perspective*.

As a result, might it be that we find that national reforms have been inspired by the existence of specific policies in certain leading countries which became 'models' for the other ones? Will we be able integrate this representation of the transplantation in the measurement of convergence? Are the usual indexes of convergence sensitive to this type of foreign impact? Will we find countries which would be more 'attractive' than others in the development of the social welfare systems? Will we lead to reconsidering the measurement of convergence in terms of the **attractiveness** between countries?

This paper is an exploratory one for two main reasons. First, it mainly focuses on methodology and does not endeavour to provide a complete analysis of all the types of

[1] A first version of this paper was presented in the research seminar on *European Ideas and Actions, their impacts on social and health policy, and on the Nordic and other European models*, co-organised by NordWel, the Institute for Future Studies, Stockholm, RECWOWE and the Centre for European studies at Sciences po Paris, Stockholm, March 26-27, 2009.

convergences in social welfare systems. Secondly, the tools which are presented remain at the descriptive level, without any stochastic inference analysis. The paper commences by surveying certain methodological problems in the measurement of convergence in the social welfare systems (Section 1). Section 2 analyses how to integrate the inter-country comparison into the usual measurement of convergence, especially in σ–convergence, that is into the variation of the dispersion between the countries. Section 3 then describes a new methodology to represent the attractiveness between countries

## Section 1 Convergence in social welfare systems: What do we represent and how do we do it?

Many papers and books (0'Connor, 2007), explain the economic and institutional meanings of convergence in social welfare systems. In this section we only recall the main methods which are used in its assessment. The empirical analysis of convergence has to provide answers to three main questions:

- Convergence towards what?
- Convergence between whom?
- What measurement of convergence?

### 1-1 Convergence towards what?

Empirical studies (see the survey of O'Connor, 2007) on convergence in social welfare systems of the developed countries show that the trajectories of the systems lead to a convergence of the statistical data (per capita social expenditure, percentage of social expenditure in GDP, financing schemes). The convergence of benefits and financing are often conceived as resulting from internal mechanisms of social welfare systems and socioeconomic factors largely linked to globalisation and Europeanisation, and can be explained by two main types of theoretical arguments (Bouget, 2003)., i.e., the economic theory of convergence on the one hand, theories in law on the other (Legrand 1996, Markesinis, 1994, Teubner, 2001, Watson, 1993).

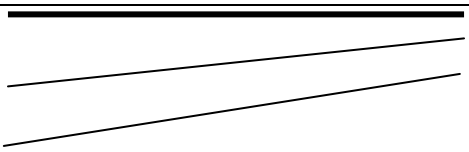
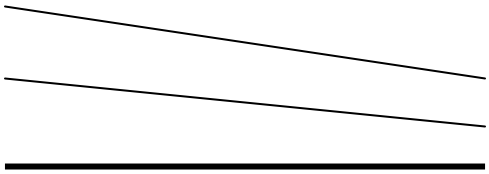
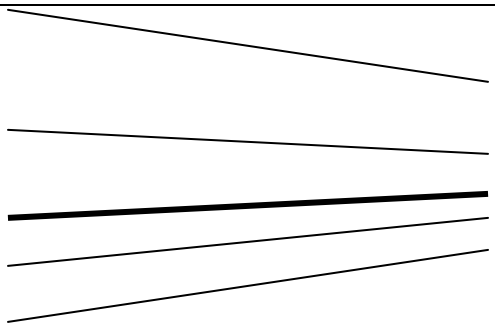
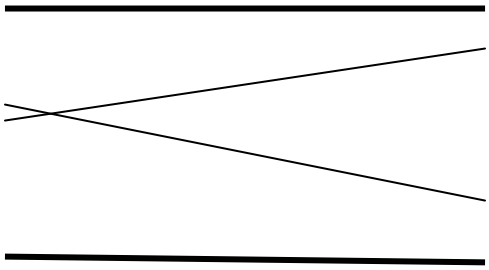
Two main traditional economic theories explain economic convergence, economic growth theory and international trade theory in a process of international openness. In addition, social welfare economics explains the relationship between social welfare, inequality and the properties of the empirical measurement of income inequality. For several decades a large number of papers have analysed the empirical measures of inequality based on the theories of the social welfare, that is on certain types of justice principles and the inequality aversion in society (Chakravarty, 1990). However, despite a positive relation between the percentage of social expenditure in GDP and economic growth (ILO, 2001:82), it is difficult to directly link convergence in GDP and convergence in social welfare systems. In short, this difficulty arises because most of the social benefits are non-tradable (Alsasua et al., 2007) whereas the convergence in GDP partly results from the globalisation of the economic exchanges.

The analysis of convergence in the social welfare states has been founded more on institutional, legal and political approaches. In all the developed countries, the social welfare systems are based on national legal schemes which change in accordance with the different reforms. Both the 80s and 90s were characterised by a powerful movement towards legalism: the goal of *Social Europe* being not only to imagine European solidarity but also to build common social rights throughout Europe. The development of the Single Market comprises rules connected with the protection of employees at work and of European citizens (Smits,

1999). The Community Charter of the Fundamental Social Rights of Workers was adopted in 1989. Europe has also built methods of harmonisation and coordination of policies, especially in relation to social policies: the Co-ordination Regulation (1971), the recommendations on the sufficient resources and the convergence of objectives in 1992, the Lisbon decisions and the open method of coordination (2000), the Leaken indicators on employment and well-being, etc. However, the permanent reference to social cohesion or inclusion often remains vague and does not impose common rules upon any national social policies. The principle of subsidiarity (Fouarge, 2004), thus maintains the autonomy of the national systems.

Finally, the discourses on convergence (Kitschelt et al. 1999) implicitly or explicitly refer to at least three models of convergence. The first one is **upwards convergence**, which means that the European model is inspired by the most developed systems in Europe, the Scandinavian countries for instance. When the Southern countries entered the European Community, they were requested to make an effort to develop their national social welfare states. The second route is **downard convergence**, that is, a European trend which means a retrenchment of the most developed countries towards the less developed social welfare states. This trend is very often associated with a process of privatisation of the systems.

**Table 1 Types of convergence**

| Type of convergence | Trends between two dates |
|---|---|
| Upwards convergence |  |
| Downward convergence |  |
| Mean convergence |  |
| Club convergence<br>Polarised convergence |  |

The third direction is **mean-convergence**, i.e. the convergence of countries towards the mean of the distribution, which would reflect a European model of social welfare systems as a compromise between the most and the less developed, in order to avoid an excessively wide gap between them.

The fourth route would be a mix of the previous ones towards a **club convergence** (Baumol, 1986), which means that the convergence or divergence would not be a general trend but a mix of several club convergences, a downward convergence among some countries and another club upwards convergence with a general trend which could be divergent from the first group. Table 1 shows a simplified picture of the four types of convergence trends. This paper will appraise certain traits of the three first types of convergence but will not analyse specific club convergence (Quah, 1996) or the polarisation phenomenon (Wolfson, 1994, Esteban & Ray, 1994).

### 1-2 Data and variables

The notion of convergence begins with the idea of differences between countries and the gradual narrowing of these differences. The analytical problem is that we can compare (in the

sense of legitimacy) different situations. In other words, we admit the principle of comparability between countries and comparability over time (Hantrais, 2008, Clasen, 2007).

The analysis of the convergence requires the definition of three types of domain: the variables which are used in the representation of convergence, the countries which are chosen in the analysis of convergence and, finally, the indicators which are built to evaluate the convergence.

### 1-2-1 Variables

Economists have largely analysed the long-term convergence/divergence between the mean income of significant sets of countries or regions. The analysis of the mean income convergence has been implicitly or explicitly justified and legitimated by the supposedly strong link between the social welfare and the inequality of a nation. In democratic and market-oriented countries, income is seemingly the main proxy of individual well-being, and inequality is thus supposed to decrease. The analysis of the economic convergence is partly inspired by the same idea when the studies use the indicators of σ–convergence.

When we analyse convergence in social welfare systems, the first question concerns the choice of variables to represent convergence in social welfare systems Clasen and al. (2008) provide several types of analyses. One way is to analyse a set of diverse **disaggregated variables** because we have to measure the convergence between systems and not only one variable or feature. For instance, we have to look at the convergence in law as the result of the reforms in the countries. In this case, the analysis is often based on Boolean terms, such as 'before the reform' and 'after the reform' of a set of variables. The analysis of systems supposes that we measure the set of different types of variables: nominal, ordinal and quantitative variables. The advantage of using this approach is that we catch the diversity of countries and variables in the analysis of convergence. However, the drawbacks are also very well known i.e. the relative height of each variable in the analysis and the type of aggregating or clustering methods. The convergence between structures is more complicated to assess because certain elements in the sets can converge while other elements are diverging.

Another common approach is to select one variable, a proxy variable which summarises the quality of the social welfare regime in each country. The most well known variables are the percentage of social expenditure in GDP and /or the social benefit per recipient or per inhabitant. The use of certain proxies in the long-term is questionable because its meaning changes over the long period under analysis. For instance, a high value of the per capita benefit can be considered as an index of the 'generosity' of a system on the one hand, and an indicator of social dependency in society on the other hand. This means that the indicators always mirror certain systems of values which can change over time. Furthermore, whatever the types of variables we have also to take into account the relationships between the variables which are sometimes technical or definition relations. For instance:

Per capita social expenditure = social expenditure/GDP * Per capita GDP

This means that we cannot analyse the convergence of one variable without taking into account the technical relations with other variables.

### 1-2-2 Data units: The countries

All the analyses of convergence between countries, whatever the variables being analysed, are based on a fixed number of countries, during a certain period of time. The analysis of the per capita income is based on a large number of countries (Penn tables). The statistical analysis of social welfare convergence is very often based on OECD statistics or Eurostat data. The

first methodological problem is the stability of the borders of the countries. In fact, the size of certain countries have changed throughout history. The current European Union has experienced two opposite movements in the past. For instance, Germany was confined to the Federal Republic and, since 1990, Germany has become a reunified country. In 1993, the Czechoslovakian federation was dissolved and two separate independent states were established. Such changes obviously produce impacts on data time series.

The second problem is the variation in the number of countries. Table 2 shows the dates of admission of new members in the European Community and the European Union. If we strictly use time series, from a historical perspective, an analysis of convergence would be limited to European member states means starting with 6 countries, gradually including new countries and finally comprises 27 countries.

Does the analysis of the convergence process use the data spanning several decades (1980-2003) for the 27 countries, including the period of non-membership, or do we strictly obey the institutional history? Do we analyse the data of the 27 countries over a long period or do we have to take into account the calendar of entrance of new countries since the Treaty of Rome?

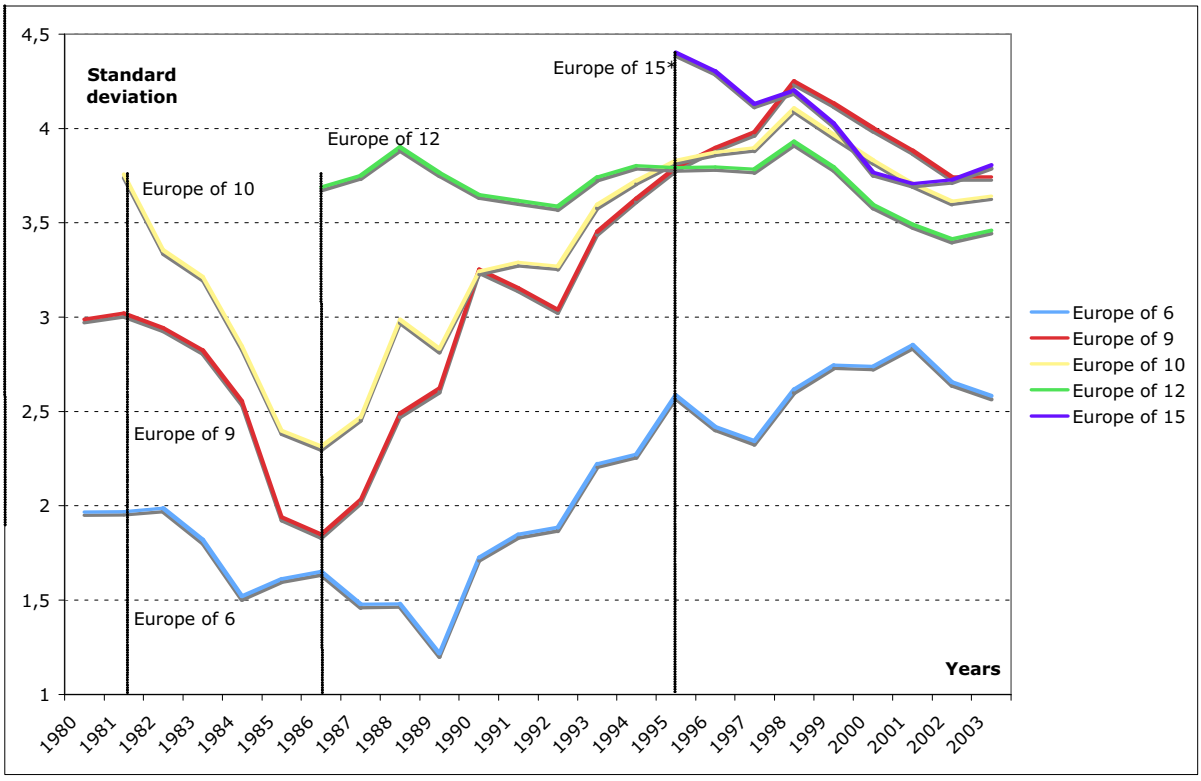
In 1973, the entrance of Denmark (with a higher social welfare than the Six) on the one hand and Ireland and the UK (less than the Six) on the other hand, caused a divergent effect. In 1981 and 1986, the entrance of the Southern countries again generated a divergent effect because their percentage of social expenditure was less than in UK and Ireland. In 1995, the entrance of the Austria, Finland and Sweden again produced a new divergent impact mainly because of the Nordic countries.

In 2004 and 2007, the entrance of the countries from the post communist countries again produced a new divergent impact. In this case, the classification of the countries according to the Human Development Index is highlighting. In 2004, the EU-15 countries were ranked among the 33 highest countries. The new member states (Slovenia, … Latvia) were ranked between 29$^{th}$ and 47$^{th}$ place. In 2006, Bulgaria and Romania were ranked in 56th and 62$^{nd}$ place.

**Table 2 Entrance dates of the countries in the EC or EU**

| Date | Member states | Number of member states |
|---|---|---|
| 1957 Treaty of Rome | Germany, Belgium, France, Italy, Luxembourg, the Netherlands | 6 |
| January 1, 1973 | Denmark, Ireland, United Kingdom | 9 |
| January 1 1981 | Greece | 10 |
| January 1986 | Spain, Portugal | 12 |
| 1990 | Extension of Germany | 12 |
| January 1995 | Austria, Sweden, Finland | 15 |
| May, 1 2004 | The Czech Republic, Slovakia, Slovenia, Poland, Hungaria, Cyprus, Malta, Latvia, Lithuania, Estonia | 25 |
| January 1 2007 | Bulgaria, Romania | 27 |

**Figure 1 Evolution of the dispersion of social expenditure in GDP, according to the number of countries in the European Community**




Sources: OECD; *Europe of 15 (Data of Austria are absent)

The Figure 1 provides an illustration of the phenomenon of integration of new countries in the European Community. At each enlargement of the European Community, the dispersion of

the percentage of social expenditure in GDP is higher than the previous ones. This means tht the new countries were characterised either by higher social welfare states of by lower ones.

Finally, the process of entrance into the EC or EU has been characterised by new members states which were experiencing either higher social welfare systems (Scandinavian countries) or, more frequently, less developed ones (Southern and post communist countries) before entering. In fact, it is obvious that each entrance of a new member has entailed an automatic divergent effect in the new European group of member states.

All the analyses of the convergence process of social welfare systems in the OECD countries show a cycle more than a clear long-term trend of convergence. Therefore, when we study long-term convergence, most of the current European member states did not belong to the European Community in the early 80s. The question is now whether the phases of convergence in OECD time series were the result of integration into the EU countries, or whether they were the result of preparations for such admission.

This problem is not specific to the definition of the European Union and its variable number of member states. For instance, Wilenski (2002), defines the 'Rich democracies' as a constant club of 19 countries (Wilenski, 2002, xxvi). Nevertheless, it is obvious that some countries could enter or exit from the club when we study the convergence over a long period.

Besides the problem of the statistical unit (country), another problem is the period of analysis. The longer the period, the less the number of countries.

In spite of these methodological problems, the real choice of the countries and the periods is almost always defined by the quality and the availability of data. We will use the OECD data on social expenditure in 21 countries: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Japan, Luxemburg, the Netherlands, New Zealand, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, from 1980 to 1999, and another series comprising 20 countries (the same set of countries without Turkey), from 1980 to 2003.

1-3 Statistical methods of analysis

Many studies have attempted to assess convergence in economies through the long-term trend of per capita GDP (Le Pen, 1997). This means that the type of variables is always a quantitative one. Three main methods have been developed: σ–convergence which analyses the variation of the coefficient of dispersion, β–convergence which analyses the differences between national economic growth (Barro et al. 1990), and the gamma-convergence (Boyle & McCarthy, 1997, 1999) which analyses the changes in ranks between countries. There are many papers on the theoretical and empirical properties of the different measures.

Section 2 and Section 3 will totally focus on the σ–convergence methods. Prior to these, a short comment on the non-quantitative variables will provide a simple explanation of the relation between the conception of convergence and the tools we use in empirical analysis. We start with the simplest of situations, the diffusion of a new national social policy within new countries such as the gradual adoption of a national minimum income in European countries, or the reforms in pensions from a PAYG system to a funded one for instance. When a country has changed a policy after a reform, the question is how to analyse this change in terms of convergence/divergence. Let us suppose a set of countries have adopted a PAYG system for a long time and one of these countries then decides to adopt a funded system. How do we represent this change in terms of convergent or divergent event? First of all, one country is divergent from its initial situation. This change is also a divergent event from the other countries which remain stable and it is a convergent trend towards a new system, the funded one. The overall conclusion will depend on the reference in the analysis. From a PAYG point of view it is a divergent trend and from a funded point of view, it is a convergent trend (attractiveness of the model). A third point of view is the reference to the diversification (entropy). In this case, we can conclude that the changes of the first countries will increase the diversification from the divergent trends of an increasing number of countries. The diversification will be maximum when half of the group of countries stay in PAYG and the other half are in funded systems.

This example mainly means that the analysis of convergence will depend on the underlying objectives we refer to. Thus, we come back to the following question: what is the meaning of convergence, or what is the objective and how is it possible to translate this objective into a method of evaluation?

## Section 2- Inter-country comparison in the σ–convergence

The statistical measurement of the convergence is often based on the σ–convergence, that is the variation of a coefficient of dispersion or inequality over a long-term period. The choice of a specific coefficient or indicator is not neutral, The calculation reflects some implicit hypotheses on the way of life in society. At the first glance, we could say that the σ–convergence would reflect the mean-convergence because the distance is based on the difference between the value of social expenditure in each country and their mean, each year. Shortly speaking, the analyses often use the variance, the standard deviation or the coefficient of variation as the measurement of the differences and they conclude that there is a trend of convergence when the coefficients decrease over time.

Very often, the empirical analysis of convergence in the national social welfare systems is based on the percentage of social expenditure in GDP. We will not analyse here the advantages and weaknesses of this choice of data which is well known today. Our objective is

more the analysis of the statistical tools which are used for this data. Given the variable a relative one, a percentage, the most appropriate coefficient is the standard deviation rather than the coefficient of variation (Micklewright J. & Stewart K., 1999).

The following comments use the percentage of social expenditure in GDP among the OECD countries from 1980 to 2003. Many studies (O'Connor, 2007) have highlighted that rather than a general trend of convergence, the reality is more a cycle. Figure 2 (bottom line) again shows this cycle between 1980 and 2003. In a previous paper (Bouget, 2006a), I concluded that this type of convergence was characterised by the absence of model.

Now, we will introduce a systematic idea of comparison between countries (inter-country comparison) and we will see what new information provides in the methodology of σ–convergence.

2-1 The variance approach

The variance and the standard deviation are based on the metrics of distance which means that we compare each value of one country to the mean of the distribution at one date:

$$d_{it} = \left(x_{it} - \bar{x}_t\right)^2$$

If we suppose that the changes in a national social welfare system is inspired by a comparison to another country, this means that the variance of a variable which is based on the constant comparison between countries and their average functions in the same manner as when we compare the countries to the 'average country', that is the countries which have the same (or the nearest) value as the average.

Table 3, lists the countries which are the nearest ones to the average value of the percentage of social expenditure in GDP, which is used in the calculation of the standard deviation each year between 1980 and 2003. The result is striking: over a long period, the average country often changes. UK or Spain, for instance, are often located in the middle of the distribution of the percentage of social expenditure in GDP.

**Table 3 Countries near to the average of the percentage of social expenditure in GDP**

| Years | Country | Years | Country | Years | Country |
|---|---|---|---|---|---|
| 1980 | NZ | 1988 | SP or IRL | 1996 | SP |
| 1981 | UK | 1989 | SP or IRL | 1997 | SP |
| 1982 | UK | 1990 | GR or I | 1998 | GR |
| 1983 | UK | 1991 | L | 1999 | SP |
| 1984 | NZ | 1992 | CA | 2000 | L |
| 1985 | UK | 1993 | CA | 2001 | P |
| 1986 | UK | 1994 | I or SP | 2002 | GR |
| 1987 | UK | 1995 | SP | 2003 | GR |

Suppose now that, instead of using the average $\bar{x}$ in the formula of the standard deviation, we used the annual value of one country (country A for instance) as a 'model', always that country and whatever the years. Therefore, the distance between one country and the 'model' is measured by the metrics:

$$d_{iAt} = \left(x_{it} - x_A\right)^2$$

We can repeat this calculus on the 21 countries (data including Turkey, 1980-1999) or on 20 countries (without Turkey, 1980-2003). We only present the cycles of 20 countries over a long period (1980-2003) on the Figure 2. The cycles on data including Turkey follow similar cycles.

**Figure 2 Trends of country-convergence**

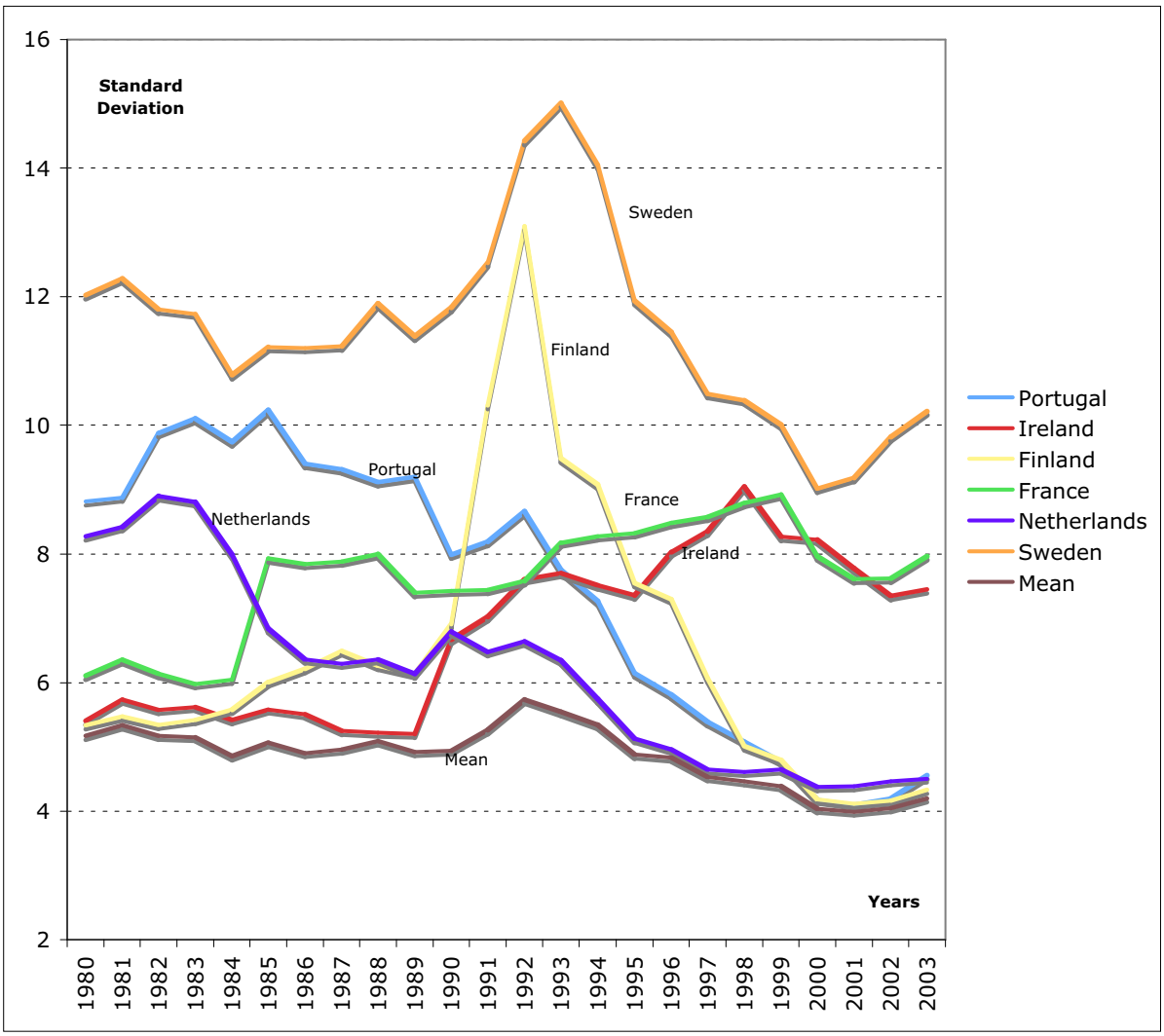



Figure 2 shows the trends of the σ–convergence for several selected countries which illustrate some of the main characteristics of convergence/divergence. The mean-convergence (standard deviation calculated with mean $\bar{x}$) provides the line at the bottom of the Figure because the standard deviation is always lower than any other 'standard deviation' measurement which would use another constant value $x_A$ of a country A instead of the mean $\bar{x}$ (Annex 1). Figure 1 illustrates certain trends of a country-convergence, which means that the deviation is calculated according to the values of one country instead of the mean. In fact, this analysis, rather than to show a convergence or a divergence, mainly shows the role of the country which is chosen in the overall cycle.

Roughly speaking, the higher the annual difference between $x_A$ and the mean $\bar{x}$, the higher the 'standard deviation'. For instance, when we choose the values of Sweden as a model country, the evolution of the 'standard deviation' is explained by the higher distance between the Swedish values and the general average of the distribution. This means that if we

compared all the countries data to the values of Sweden, we would obtain a huge cycle of convergence and divergence. The cycle with Finland as a model illustrates Finland's economic crisis in 1991. When UK, New Zealand, Greece, Spain or Italy are used as a model country, the lines are very close to the cycle of the mean convergence. In order to facilitate the reading of Figure 2, they have been dropped. Finland, Denmark, Japan, Sweden (and Turkey) also lead to a cycle.

However, the reference to certain countries do not lead to the same form of convergence/divergence trend. Luxemburg, the Netherlands, Australia, Portugal and Belgium lead a permanent convergence without any clear cycle effect. The paradoxical situation of Ireland comes from the decrease in its social expenditure in GDP largely due to its strong economic growth. Three other countries (France, Germany, Canada) do not show a clear cycle.

The calculation of the correlation coefficients between the series of mean-convergence and each country-convergence trend provides a classification of countries in Table 4. Many series are close to the mean-convergence/divergence cycle. Contrary to these trends, two countries do not participate in the cycle of convergence/divergence: France and Ireland (Figure 2 and Table 4).

**Table 4 Correlation between the 'country-convergence' and the mean-convergence**

| Countries | Correlation | Countries | Correlation |
|---|---|---|---|
| Japan | 0.96 | Belgium | 0.73 |
| Italy | 0.94 | Luxembourg | 0.71 |
| Spain | 0.94 | Netherlands | 0.70 |
| United Kingdom | 0.93 | New Zealand | 0.69 |
| Sweden | 0.89 | United States | 0.63 |
| Switzerland | 0.93 | Denmark | 0.61 |
| Turkey | 0.95 | Canada | 0.05 |
| Greece | 0.86 | Germany | 0.02 |
| Australia | 0.84 | France | -0.33 |
| Portugal | 0.77 | Ireland | -0.43 |
| Finland | 0.74 | | |

## 2-2 The Gini approach

The Lorenz curve and the Gini coefficient are key elements in the analysis of income inequality and a sizeable literature details their numerous theoretical and mathematical properties. For at least one decade certain authors have advocated the use of the Gini coefficient rather than Standard Deviation in the analysis of σ–convergence, citing both theoretical and empirical reasons. Wodon and Yitzhaki (2002, 2006) have established a list of the qualities of this coefficient: a link to the general properties of the social welfare functions, its link to the notion of dominance (property of welfare dominance), the consistency with the relative deprivation theory (Runciman, 1986), the empirical robustness to outliers, its link to covariance which makes it possible to establish direct links between growth, inequality and welfare.

Rather than comparing the value of countries to the average (mean-convergence based on variance for instance), we compare each value of social expenditure in GDP to each other value and we aggregate the distances. Such an approach leads to the use of the Gini

coefficient or the mean difference. When we analyse the inequality between relative values such as the percentage of social expenditure in GDP, we may use the mean difference (Micklewright J. & Stewart K., 1999) instead of the Gini coefficient. Furthermore, as in section 1, the number of countries remains constant: either 21 countries, including Turkey, from 1980 to 1999 or 20 countries without Turkey, form 1980 to 2003. Then, we may calculate the sum of differences $D_t$, and its evolution.

2-2-1 Sum of distances

The distance between two countries i and j in the year t is defined by the following metrics:

$$d_{ijt} = \left| x_{it} - x_{jt} \right|$$

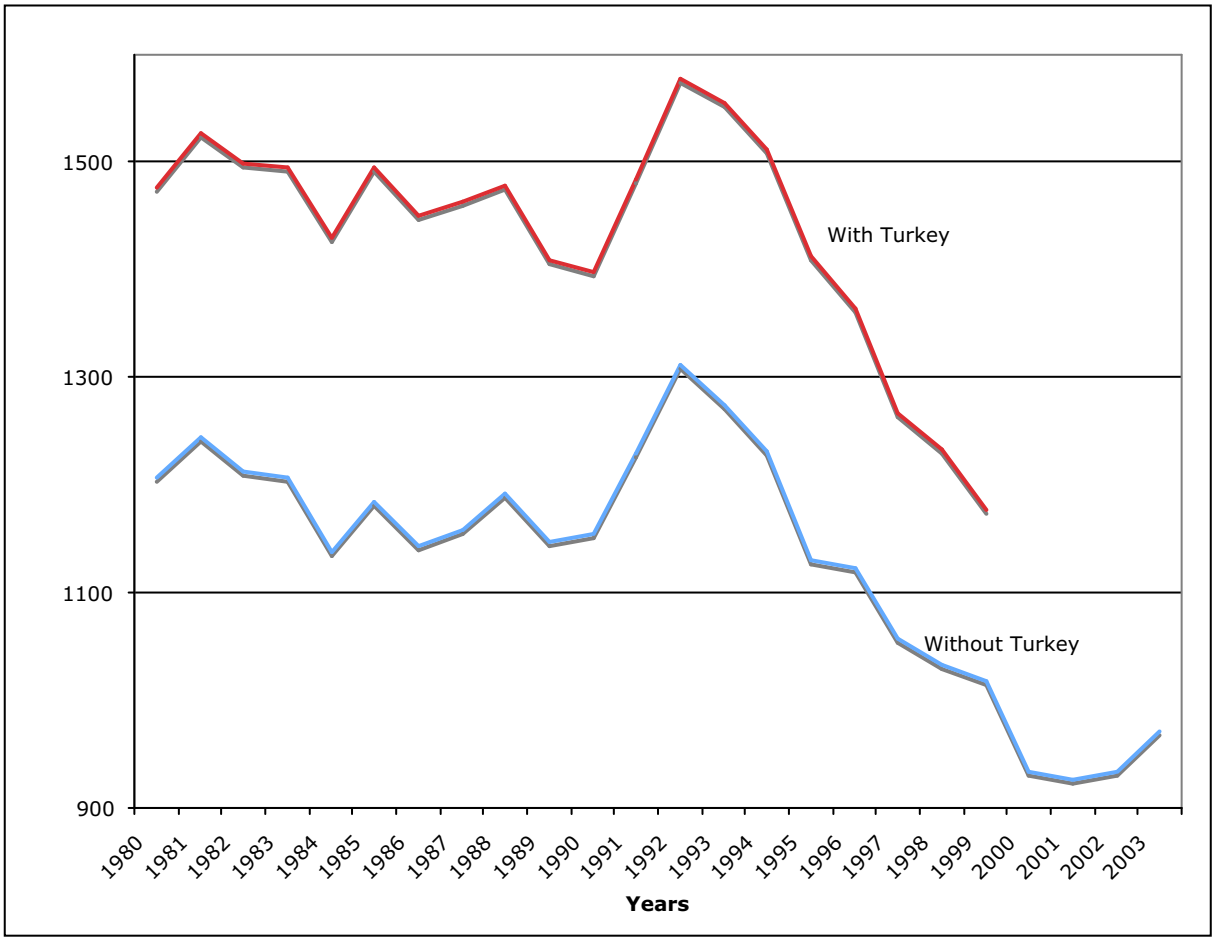
If the reforms in different countries were inspired by the success or the failure of the experiments on the other countries, the distance $d$ between two countries would decrease (convergence) or increase (divergence).

$D_t$ is the aggregation of the distances and is simply the sum of all the distances between pairs of countries at the date t (Annex 2):

$$D_t = \sum_i \sum_j d_{ijt}$$

Figure 3 represents the values of $D_t$ in two series: the first one comprises 21 countries including Turkey from 1980 to 1999 and, the second 20 countries (without Turkey due to the absence of data since 2000), from 1980 to 2003.

**Figure 3 Evolution of the sum of distances between countries from 1980 to 2003**




Sources OECD data; 1980-1999 with Turkey; 1980-2003 without Turkey (since 2000 the data of Turkey have been absent).

This method beckons the same conclusion as the variance coefficient on the convergence/divergence cycle. Furthermore Figure 3 shows the substantial height of Turkey in the calculation of the sum of distances at one year because of the gap between itself and the other countries. However, when we compare the evolution of the two series, we can see that the Turkey does not dramatically influence the cycle of convergence/divergence.

The analysis of distance D also may provide two other results: the relative height of each country in the process of convergence and the frequency of convergence of the countries during the period 1980- 1999 or 1980 and 2003.

2-2-2 Gross convergence and country height

The variation of a Gini coefficient or of the aggregated distance D measures either the net convergence or the net divergence of annual variations between pairs of countries. Sometimes the variation is negative (convergence) sometimes positive or zero (non convergence). Some countries converge with each other whereas other countries diverge among themselves and the result is:

Net convergence/divergence = Gross convergence (negative values) + Gross divergence (positive values)

This decomposition may provide the participation of each country in the total gross convergence between two successive years and we add all the annual variations (Annex 2-2).

Table 5 summarises the total gross decrease in the distance between all the pairs of countries 21 countries) from 1980 to 1999. This table is a symmetric matrix with 0 on the diagonal. Furthermore, the countries in the table are ranked from the highest convergent country (Finland) to the country which contributes very minimally to the convergence process. This calculation provides some new information on the process of convergence:

- The gross convergence is widely diffused and not concentrated within given countries;
- The countries which contribute most in the convergence are Finland, mainly due to the high convergence process after 1991 towards the other countries, Turkey and Greece. However we cannot generalise as regards the other Southern countries;
- Contrary to this, France and US minimally participate in the convergence process;
- In the variance analysis, Ireland was totally out of the process of convergence, mainly because the gap between the trend of social expenditure in Ireland compared to the trend of the OECD average was increasing. In the Gini approach and the inter-country comparison, Ireland significantly participates in the convergence process.

**Table 5 Absolute contribution of countries in the gross convergence process between 1980 and 1999**

| | FI | GR | T | NL | IRL | L | P | S | DK | NZ | CA | I | CH | AS | J | SP | UK | GER | B | FR | US | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FI | | 18,6 | 15,2 | 12,8 | 11,4 | 16,0 | 15,4 | 12,0 | 15,7 | 9,5 | 9,3 | 11,8 | 11,8 | 10,1 | 12,8 | 11,8 | 10,6 | 13,6 | 13,9 | 11,0 | 9,6 | 252,8 |
| GR | 18,6 | | 7,0 | 16,0 | 13,0 | 14,5 | 7,3 | 16,0 | 16,2 | 12,3 | 8,4 | 11,3 | 9,7 | 4,6 | 3,9 | 9,6 | 9,0 | 13,2 | 10,1 | 9,4 | 6,9 | 216,9 |
| T | 15,2 | 7,0 | | 13,8 | 15,6 | 13,1 | 6,5 | 12,0 | 10,1 | 9,6 | 9,8 | 7,1 | 9,6 | 7,7 | 7,4 | 8,2 | 10,9 | 10,0 | 9,1 | 8,1 | 8,4 | 199,2 |
| NL | 12,8 | 16,0 | 13,8 | | 11,5 | 4,6 | 14,9 | 3,7 | 3,7 | 10,0 | 8,5 | 10,3 | 12,2 | 11,6 | 11,3 | 10,2 | 11,8 | 5,0 | 3,6 | 4,5 | 8,0 | 187,7 |
| IRL | 11,4 | 13,0 | 15,6 | 11,5 | | 9,6 | 12,9 | 9,2 | 8,7 | 9,4 | 9,6 | 5,3 | 8,9 | 11,1 | 11,7 | 9,3 | 2,7 | 6,3 | 6,2 | 2,8 | 10,1 | 185,4 |
| L | 16,0 | 14,5 | 13,1 | 4,6 | 9,6 | | 11,4 | 7,9 | 7,0 | 9,6 | 12,0 | 8,8 | 10,5 | 10,0 | 8,3 | 10,6 | 8,6 | 4,2 | 3,4 | 4,8 | 6,4 | 181,3 |
| P | 15,4 | 7,3 | 6,5 | 14,9 | 12,9 | 11,4 | | 11,2 | 11,4 | 13,6 | 8,8 | 9,5 | 7,1 | 2,4 | 1,8 | 6,9 | 8,9 | 7,7 | 8,5 | 5,5 | 4,4 | 176,2 |
| S | 12,0 | 16,0 | 12,0 | 3,7 | 9,2 | 7,9 | 11,2 | | 7,5 | 8,1 | 7,5 | 10,1 | 8,5 | 9,7 | 9,8 | 6,4 | 7,0 | 6,9 | 6,8 | 10,0 | 5,7 | 175,8 |
| DK | 15,7 | 16,2 | 10,1 | 3,7 | 8,7 | 7,0 | 11,4 | 7,5 | | 6,0 | 9,0 | 9,7 | 7,0 | 9,2 | 7,8 | 8,2 | 9,3 | 7,9 | 8,2 | 7,6 | 4,1 | 174,3 |
| NZ | 9,5 | 12,3 | 9,6 | 10,0 | 9,4 | 9,6 | 13,6 | 8,1 | 6,0 | | 7,4 | 5,4 | 9,7 | 9,7 | 9,8 | 6,9 | 6,9 | 6,5 | 5,4 | 4,9 | 6,1 | 166,9 |
| CA | 9,3 | 8,4 | 9,8 | 8,5 | 9,6 | 12,0 | 8,8 | 7,5 | 9,0 | 7,4 | | 6,5 | 7,4 | 6,6 | 8,0 | 4,2 | 6,3 | 7,7 | 6,8 | 6,0 | 4,5 | 154,1 |
| I | 11,8 | 11,3 | 7,1 | 10,3 | 5,3 | 8,8 | 9,5 | 10,1 | 9,7 | 5,4 | 6,5 | | 5,4 | 7,6 | 6,0 | 6,0 | 4,8 | 6,9 | 6,0 | 5,4 | 4,0 | 147,7 |
| CH | 11,8 | 9,7 | 9,6 | 12,2 | 8,9 | 10,5 | 7,1 | 8,5 | 7,0 | 9,7 | 7,4 | 5,4 | | 4,9 | 6,1 | 5,5 | 5,6 | 4,4 | 5,5 | 3,0 | 3,3 | 146,3 |
| AS | 10,1 | 4,6 | 7,7 | 11,6 | 11,1 | 10,0 | 2,4 | 9,7 | 9,2 | 9,7 | 6,6 | 7,6 | 4,9 | | 4,6 | 5,3 | 6,4 | 6,4 | 7,3 | 4,9 | 3,2 | 143,3 |
| J | 12,8 | 3,9 | 7,4 | 11,3 | 11,7 | 8,3 | 1,8 | 9,8 | 7,8 | 9,8 | 8,0 | 6,0 | 6,1 | 4,6 | | 6,3 | 6,4 | 5,6 | 5,6 | 3,4 | 4,4 | 141,1 |
| SP | 11,8 | 9,6 | 8,2 | 10,2 | 9,3 | 10,6 | 6,9 | 6,4 | 8,2 | 6,9 | 4,2 | 6,0 | 5,5 | 5,3 | 6,3 | | 5,0 | 7,0 | 5,6 | 4,6 | 3,0 | 140,5 |
| UK | 10,6 | 9,0 | 10,9 | 11,8 | 2,7 | 8,6 | 8,9 | 7,0 | 9,3 | 6,9 | 6,3 | 4,8 | 5,6 | 6,4 | 6,4 | 5,0 | | 5,2 | 4,3 | 3,9 | 3,7 | 137,1 |
| GER | 13,6 | 13,2 | 10,0 | 5,0 | 6,3 | 4,2 | 7,7 | 6,9 | 7,9 | 6,5 | 7,7 | 6,9 | 4,4 | 6,4 | 5,6 | 7,0 | 5,2 | | 4,8 | 4,7 | 3,0 | 137,0 |
| B | 13,9 | 10,1 | 9,1 | 3,6 | 6,2 | 3,4 | 8,5 | 6,8 | 8,2 | 5,4 | 6,8 | 6,0 | 5,5 | 7,3 | 5,6 | 5,6 | 4,3 | 4,8 | | 3,8 | 3,1 | 128,1 |
| F | 11,0 | 9,4 | 8,1 | 4,5 | 2,8 | 4,8 | 5,5 | 10,0 | 7,6 | 4,9 | 6,0 | 5,4 | 3,0 | 4,9 | 3,4 | 4,6 | 3,9 | 4,7 | 3,8 | | 1,6 | 109,9 |
| US | 9,6 | 6,9 | 8,4 | 8,0 | 10,1 | 6,4 | 4,4 | 5,7 | 4,1 | 6,1 | 4,5 | 4,0 | 3,3 | 3,2 | 4,4 | 3,0 | 3,7 | 3,0 | 3,1 | 1,6 | | 103,5 |

2-2-3 Frequency and years of convergences

Another approach is to turn the yearly tables of gross convergence into Boolean tables. The calculation process (Table 6) is as follows: when two countries converge between two successive years, we define the convergence by the value 1, or else 0. We obtain a table which is symmetric with the value 0 in the cells which represent an absence of convergence and 1 in the cells which represent a convergent event between two countries.

**Table 6 Matrix of convergence between three countries, between two years**

| | A | B | C |
|---|---|---|---|
| A | 0 | 1 | 0 |
| B | 1 | 0 | 1 |
| C | 0 | 1 | 0 |

This matrix is symmetric with 0 on the diagonal. In Table 6, A and B converge, B and C converge but A and C do not converge.

We apply this calculation rule to the annual OECD data of the percentage of social expenditure in GDP, from 190 to 1999 on 21 countries (including Turkey). We obtain 19 tables of Boolean values from 1980 to 1999. These tables provide the following information: the identification of the countries which converge and the identification of the years of convergence. Table 7 is an example of the pairs convergence process between 1980 and 1981. In this table, when the distance between two countries decreases between 1980 and 1981, this means the pair distances of the percentage of social expenditure in GDP in 1981 is lower than in 1980 and the corresponding cell equals 1. When there is not any convergence, the cell is 0. The characteristic of this matrix is that it is a symmetric one because when country A converges towards B, the reciprocal is also true, B converges to A. We repeat this calculation for the successive years: 1982 compared to 1981, etc. The global result of the calculations is that we obtain 19 similar tables containing Boolean values (Table 7).

From this new information, it is possible to pursue different types of investigations. At this preliminary stage, we sum up all the tables in a synthetic one (Table 8). A cell in this table represents the number of annual convergences between two countries. This table is also a symmetric one. Finally, the rows and the columns have been ranked from the highest total frequency of convergence to the lowest one.

When comparing Table 5 which provides the height of the gross convergence between all the pairs of countries and Table 8 which describes the number of annual pair convergences, some results are similar, mainly the role of Turkey and Greece in the process of convergence or, on the contrary, the lesser role of France or US in the process of convergence. However, Figure 4 shows that the correlation is not very strong.

**Table 7 Convergence between OECD countries, between 1980 and 1981**

| | AS | B | CA | DK | FI | F | GER | GR | IRL | I | J | L | NL | NZ | P | SP | S | CH | T | IK | US | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AS | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 3 |
| B | 0 | | | 1 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 4 |
| CA | 0 | 0 | | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| DK | 0 | 1 | 1 | | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 14 |
| FI | 0 | 0 | 1 | 1 | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 7 |
| F | 0 | 0 | 0 | 1 | 0 | | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 8 |
| GER | 0 | 0 | 0 | 1 | 0 | 1 | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 7 |
| GR | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 16 |
| IRL | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 7 |
| I | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 7 |
| J | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 7 |
| L | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 4 |
| NL | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 8 |
| NZ | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 6 |
| P | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | | 0 | 0 | 1 | 0 | 0 | 1 | 8 |
| SP | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | | 1 | 0 | 0 | 0 | 0 | 9 |
| S | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | | 0 | 0 | 1 | 0 | 7 |
| CH | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | | 1 | 0 | 1 | 6 |
| T | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | 0 | 0 | 3 |
| IK | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | | 0 | 8 |
| US | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | | 7 |
| Total | 3 | 4 | 6 | 14 | 7 | 8 | 7 | 16 | 7 | 7 | 7 | 4 | 8 | 6 | 8 | 9 | 7 | 6 | 3 | 8 | 7 | |

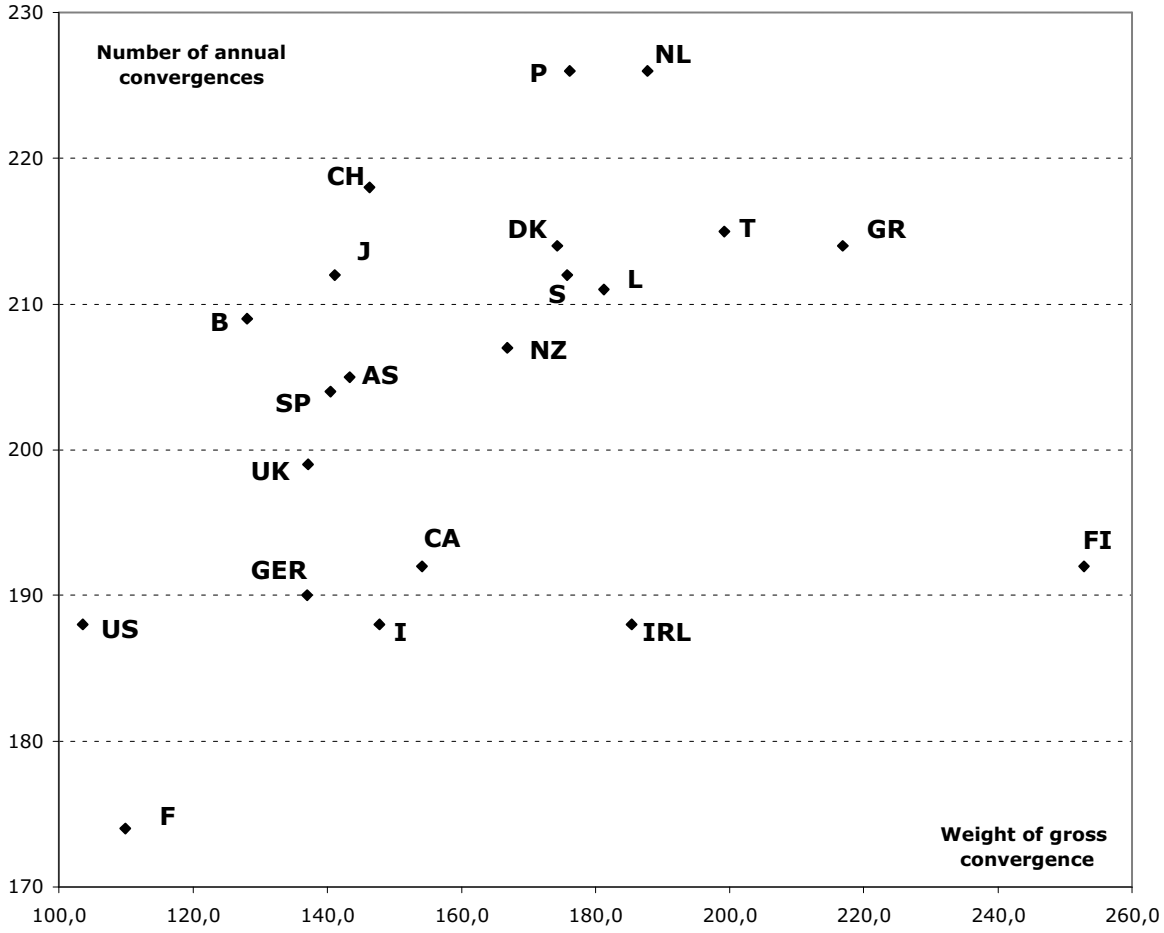
Reading: Denmark and Belgium converge between 1980 and 1981;

**Table 8 Number of annual convergences between pairs of countries, from 1980 to 1999**

| | NL | P | CH | T | DK | GR | J | S | L | B | NZ | AS | SP | UK | CA | FI | GER | IRL | I | US | FR | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NL | 0 | 15 | 16 | 14 | 6 | 14 | 14 | 6 | 8 | 8 | 13 | 16 | 15 | 13 | 10 | 10 | 6 | 9 | 13 | 15 | 5 | 226 |
| P | 15 | 0 | 12 | 7 | 12 | 9 | 8 | 12 | 16 | 15 | 13 | 5 | 12 | 11 | 11 | 11 | 14 | 11 | 12 | 7 | 13 | 226 |
| CH | 16 | 12 | 0 | 10 | 11 | 8 | 9 | 13 | 13 | 14 | 11 | 10 | 13 | 13 | 11 | 8 | 10 | 11 | 10 | 5 | 10 | 218 |
| T | 14 | 7 | 10 | 0 | 11 | 9 | 9 | 14 | 12 | 13 | 13 | 9 | 11 | 10 | 11 | 9 | 10 | 12 | 9 | 12 | 10 | 215 |
| DK | 6 | 12 | 11 | 11 | 0 | 13 | 11 | 11 | 7 | 10 | 12 | 13 | 10 | 13 | 11 | 10 | 12 | 8 | 11 | 12 | 10 | 214 |
| GR | 14 | 9 | 8 | 9 | 13 | 0 | 9 | 12 | 14 | 15 | 12 | 8 | 9 | 12 | 9 | 10 | 12 | 10 | 11 | 6 | 12 | 214 |
| J | 14 | 8 | 9 | 9 | 11 | 9 | 0 | 10 | 15 | 11 | 11 | 9 | 10 | 11 | 11 | 9 | 12 | 14 | 8 | 13 | 8 | 212 |
| S | 6 | 12 | 13 | 14 | 11 | 12 | 10 | 0 | 7 | 10 | 10 | 12 | 12 | 12 | 9 | 13 | 8 | 8 | 12 | 10 | 11 | 212 |
| L | 8 | 16 | 13 | 12 | 7 | 14 | 15 | 7 | 0 | 6 | 10 | 13 | 13 | 11 | 12 | 12 | 7 | 8 | 10 | 11 | 6 | 211 |
| B | 8 | 15 | 14 | 13 | 10 | 15 | 11 | 10 | 6 | 0 | 8 | 13 | 9 | 8 | 9 | 12 | 10 | 8 | 12 | 10 | 8 | 209 |
| NZ | 13 | 13 | 11 | 13 | 12 | 12 | 11 | 10 | 10 | 8 | 0 | 12 | 11 | 9 | 11 | 8 | 9 | 10 | 9 | 9 | 6 | 207 |
| AS | 16 | 5 | 10 | 9 | 13 | 8 | 9 | 12 | 13 | 13 | 12 | 0 | 11 | 11 | 11 | 9 | 8 | 12 | 7 | 7 | 9 | 205 |
| SP | 15 | 12 | 13 | 11 | 10 | 9 | 10 | 12 | 13 | 9 | 11 | 11 | 0 | 9 | 7 | 10 | 10 | 10 | 6 | 9 | 7 | 204 |
| UK | 13 | 11 | 13 | 10 | 13 | 12 | 11 | 12 | 11 | 8 | 9 | 11 | 9 | 0 | 9 | 7 | 10 | 7 | 7 | 10 | 6 | 199 |
| CA | 10 | 11 | 11 | 11 | 11 | 9 | 11 | 9 | 12 | 9 | 11 | 11 | 7 | 9 | 0 | 8 | 8 | 11 | 7 | 9 | 7 | 192 |
| FI | 10 | 11 | 8 | 9 | 10 | 10 | 9 | 13 | 12 | 12 | 8 | 9 | 10 | 7 | 8 | 0 | 11 | 7 | 9 | 9 | 10 | 192 |
| GER | 6 | 14 | 10 | 10 | 12 | 12 | 12 | 8 | 7 | 10 | 9 | 8 | 10 | 10 | 8 | 11 | 0 | 5 | 10 | 7 | 11 | 190 |
| IRL | 9 | 11 | 11 | 12 | 8 | 10 | 14 | 8 | 8 | 8 | 10 | 12 | 10 | 7 | 11 | 7 | 5 | 0 | 7 | 13 | 7 | 188 |
| I | 13 | 12 | 10 | 9 | 11 | 11 | 8 | 12 | 10 | 12 | 9 | 7 | 6 | 7 | 7 | 9 | 10 | 7 | 0 | 7 | 11 | 188 |
| US | 15 | 7 | 5 | 12 | 12 | 6 | 13 | 10 | 11 | 10 | 9 | 7 | 9 | 10 | 9 | 9 | 7 | 13 | 7 | 0 | 7 | 188 |
| FR | 5 | 13 | 10 | 10 | 10 | 12 | 8 | 11 | 6 | 8 | 6 | 9 | 7 | 6 | 7 | 10 | 11 | 7 | 11 | 7 | 0 | 174 |
| Total | 226 | 226 | 218 | 215 | 214 | 214 | 212 | 212 | 211 | 209 | 207 | 205 | 204 | 199 | 192 | 192 | 190 | 188 | 188 | 188 | 174 | |

Reading: From 1980 to 1999, there are 15 times of convergence between the Netherlands and Portugal.

**Figure 4 Relation between the weight and the frequency of inter-country convergences**




Finland looks as an outlier. The reason for the difference between the significant height and a rather low frequency of convergences is striking and illustrated in Figure 4. The huge convergence of Finland is mainly due to the period 1992-2000. The role of the Netherlands is totally different. There are many annual convergences towards some other countries but each annual convergence is often small. Another feature: among the countries which do not contribute very much to convergence (US, F, GER), we note a relative high convergence (height and frequency) between the US and Ireland. On the contrary, we note a relative small frequency of convergence between the Netherlands and Denmark.

## Section 3 From convergence to attractiveness

Besides the general explanations for convergence, the global economic forces or the global trend of convergence in law, the literature on convergence has pointed to the role of the leading countries. For instance Zeitlin (1999) has analysed the transfer of technologies between countries, and the gradual hybridisation. The vocabulary such as ‘catch-up’, ‘laggards’, ‘followers’, etc. identifies a certain type of convergence between countries. Some are leaders and others imitate the leaders.

As regards social protection, the reforms in each country are partly influenced by foreign systems. Many authors in the nineties claimed that the retrenchment of the dismantling of the most developed social welfare systems caused an Americanisation of the European systems.

On the opposite route, Kauto and Kvist (2002) identified a catch-convergence of the Continental states towards the Swedish employement-centered welfare state. In the European post-communist countries Vecernik (2004:14) says that '*Researchers have begun adopting various policies from models in Western countries ...*'. Two years ago, the French government considered that Danish flexicurity policy could be a model for new reforms of employment policy. It is possible to find similar examples in all countries. Furthermore, national publications on social protection also publish increasingly frequent articles on the foreign reforms of social policies (Bouget, 2006b).

This section focuses on one methodological question: how is it possible to build indicators which measure this phenomenon?

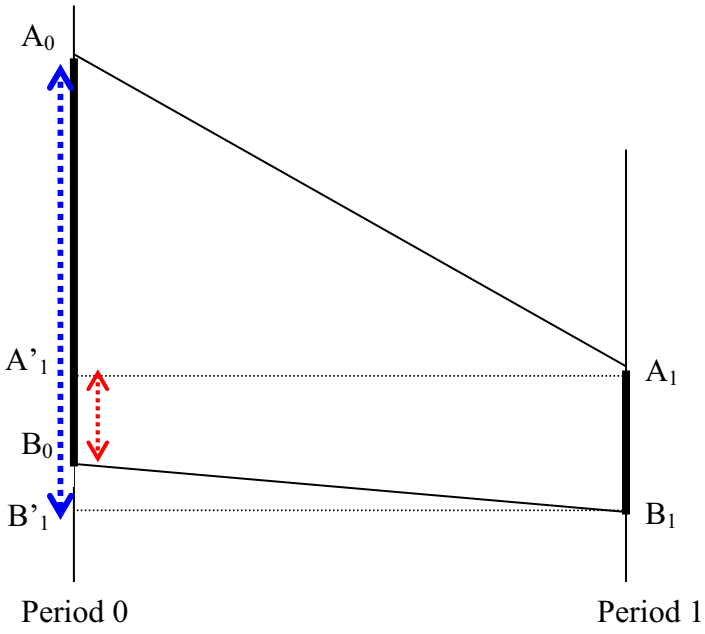
The analysis of convergence and the statistical tools do not provide a satisfactory solution. Very often, the convergence is analysed as a catch-up process. But in a convergence process the indicators do not provide an instrument for distinguishing the countries (attractors) towards which the others are converging, from the other countries which follow (attracted) the leaders. Certain studies choose one country as an attractor but it is a a-priori choice. For instance, Herce (2000) uses a time series analysis of the convergence of social benefits in Europe with a country (Germany) as a reference.

3-1 Methodology

The difference between convergence and attractiveness is illustrated in the following example of a convergence between two countries between period 0 and period 1. Figure 5 represents the trend $A_0A_1$ of a variable in the country A, and $B_0B_1$ the trend of the variable in the country B. Both experience a decrease in the values of a variable in countries A and B, and a clear convergence between them because the distance between them diminishes over time ($A_1B_1 < A_0B_0$). The Annex 3 contains a technical presentation of the attractiveness.

The difference between convergence and attractiveness is that a convergence between two countries is a symmetric relation (if A converges to B, then B converges to A). Attractiveness is different because one country can be an attractor and another country only an attracted one. When the policy-makers prepare new reforms in social welfare systems, they study other national systems. This means that they compare their own system to another past or present one. Let us suppose that country A, at time 0, wants to converge towards B, the reference in period 0 is not the future values of B in period 1 but the value of B in period 0 (or even past periods). Figure 5 shows a convergence of A (attracted) towards B (attractor) because the gap between A in period 1 and the initial value of B in period 0 has decreased ($A'_1B_0 < A_0B_0$). Country A is attracted by B. However, we do not witness the same reciprocal trend for country B. The value of country B has decreased and the comparison with the initial value of A in period 0 justifies the conclusion of a divergent effect ($A_0B'_1 > A_0B_0$). The country B is not attracted by A.

**Figure 5 Graphical representation of attractiveness between two countries.**




Finally, we can conclude that country B is an attractor for country A but that country A is not an attractor for country B. The relation between convergence and attractiveness is summarised in Table 9. The reciprocal attractiveness means that each country can attract the other countries. The unilateral attractiveness is described in Figure 5.

**Table 9 Relation between convergence and attractiveness**

| | Convergence | Non convergence |
|---|---|---|
| Reciprocal attractiveness | YES | NO |
| Unilateral attractiveness | Possible | possible |
| No attractiveness | NO | YES |

It is possible to calculate the attractiveness between pairs of countries between successive years: as Boolean variables such as in Section 2 The calculation of the attractiveness of the OECD countries follows the same scheme of calculus and provides the frequency and the sense of attractiveness between the pairs of countries (Tables 10, 11 and 12).

**Table 10 Attractiveness between countries between 1980 and 1981**

| | AS | B | CA | DK | FI | F | GER | GR | IRL | I | J | L | NL | NZ | P | SP | S | CH | T | UK | US | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AS** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 3 |
| **B** | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 14 |
| **CA** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 5 |
| **DK** | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 17 |
| **FI** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 10 |
| **F** | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 12 |
| **GER** | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 13 |
| **GR** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 4 |
| **IRL** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 7 |
| **I** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 10 |
| **J** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 3 |
| **L** | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 14 |
| **NL** | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 14 |
| **NZ** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 8 |
| **P** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 4 |
| **SP** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 6 |
| **S** | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 18 |
| **CH** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 5 |
| **T** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 |
| **UK** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 7 |
| **US** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 5 |
| **Total** | 3 | 2 | 13 | 1 | 7 | 6 | 5 | 16 | 10 | 7 | 19 | 2 | 2 | 9 | 17 | 12 | 0 | 6 | 20 | 9 | 15 | 181 |

Reading: Australia is attractor of Japan, Switzerland and Turkey (‘1’ in the first row); Australia is attracted Japan, Portugal and Turkey (‘1’ in the first column).

**Table 11 Attractiveness between countries from 1980 to 1999**

| | AS | B | CA | DK | FI | F | GER | GR | IRL | I | J | L | NL | NZ | P | SP | S | CH | T | UK | US | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AS** | 0 | 8 | 8 | 9 | 8 | 6 | 7 | 6 | 7 | 5 | 14 | 9 | 10 | 8 | 9 | 9 | 7 | 8 | 15 | 7 | 5 | 165 |
| **B** | 11 | 0 | 9 | 9 | 12 | 9 | 10 | 12 | 9 | 13 | 15 | 9 | 5 | 10 | 15 | 9 | 8 | 11 | 14 | 11 | 10 | 211 |
| **CA** | 11 | 9 | 0 | 10 | 9 | 6 | 7 | 8 | 6 | 5 | 15 | 8 | 10 | 5 | 14 | 9 | 8 | 10 | 14 | 8 | 10 | 182 |
| **DK** | 11 | 10 | 9 | 0 | 8 | 12 | 10 | 12 | 9 | 13 | 15 | 11 | 8 | 10 | 15 | 9 | 8 | 11 | 14 | 11 | 10 | 216 |
| **FI** | 11 | 7 | 9 | 10 | 0 | 6 | 8 | 12 | 9 | 9 | 15 | 9 | 6 | 10 | 15 | 9 | 7 | 11 | 14 | 11 | 10 | 198 |
| **F** | 11 | 6 | 9 | 6 | 10 | 0 | 8 | 12 | 9 | 13 | 15 | 10 | 6 | 10 | 15 | 9 | 8 | 11 | 14 | 11 | 10 | 203 |
| **GER** | 11 | 7 | 9 | 10 | 10 | 8 | 0 | 12 | 9 | 13 | 15 | 10 | 4 | 10 | 15 | 9 | 8 | 11 | 14 | 11 | 10 | 206 |
| **GR** | 10 | 9 | 4 | 10 | 9 | 6 | 7 | 0 | 6 | 6 | 15 | 8 | 9 | 8 | 15 | 8 | 8 | 12 | 14 | 9 | 8 | 181 |
| **IRL** | 11 | 9 | 11 | 10 | 9 | 6 | 7 | 7 | 0 | 7 | 13 | 8 | 10 | 9 | 11 | 12 | 8 | 9 | 14 | 9 | 12 | 192 |
| **I** | 11 | 9 | 8 | 10 | 9 | 6 | 7 | 12 | 9 | 0 | 15 | 8 | 7 | 9 | 15 | 10 | 8 | 11 | 14 | 12 | 10 | 200 |
| **J** | 8 | 9 | 10 | 10 | 9 | 6 | 7 | 7 | 10 | 6 | 0 | 8 | 10 | 9 | 6 | 10 | 8 | 8 | 14 | 8 | 8 | 171 |
| **L** | 11 | 9 | 9 | 10 | 14 | 10 | 9 | 12 | 9 | 11 | 15 | 0 | 6 | 9 | 15 | 9 | 8 | 11 | 14 | 11 | 10 | 212 |
| **NL** | 11 | 10 | 9 | 9 | 13 | 10 | 8 | 11 | 9 | 10 | 15 | 10 | 0 | 10 | 15 | 9 | 8 | 11 | 14 | 11 | 10 | 213 |
| **NZ** | 11 | 9 | 11 | 10 | 9 | 6 | 7 | 7 | 9 | 6 | 15 | 8 | 10 | 0 | 15 | 14 | 8 | 11 | 14 | 10 | 10 | 200 |
| **P** | 7 | 9 | 9 | 10 | 9 | 6 | 7 | 7 | 6 | 6 | 14 | 8 | 10 | 9 | 0 | 10 | 8 | 8 | 14 | 8 | 4 | 169 |
| **SP** | 11 | 9 | 7 | 10 | 9 | 6 | 7 | 12 | 6 | 5 | 15 | 7 | 9 | 6 | 15 | 0 | 8 | 11 | 14 | 7 | 10 | 184 |
| **S** | 11 | 10 | 9 | 9 | 10 | 13 | 11 | 12 | 9 | 13 | 15 | 11 | 9 | 10 | 15 | 9 | 0 | 11 | 14 | 11 | 10 | 222 |
| **CH** | 9 | 9 | 9 | 10 | 9 | 6 | 7 | 7 | 6 | 6 | 15 | 8 | 10 | 9 | 11 | 10 | 8 | 0 | 14 | 8 | 7 | 178 |
| **T** | 8 | 9 | 10 | 10 | 9 | 6 | 7 | 7 | 10 | 6 | 4 | 8 | 10 | 9 | 4 | 10 | 8 | 8 | 0 | 8 | 9 | 160 |
| **UK** | 11 | 9 | 6 | 10 | 9 | 6 | 7 | 10 | 8 | 3 | 15 | 8 | 10 | 7 | 15 | 12 | 8 | 11 | 14 | 0 | 10 | 189 |
| **US** | 9 | 9 | 10 | 10 | 9 | 6 | 7 | 9 | 9 | 6 | 14 | 8 | 10 | 9 | 9 | 10 | 8 | 7 | 14 | 8 | 0 | 181 |
| **Total** | 205 | 175 | 175 | 192 | 193 | 146 | 155 | 194 | 164 | 162 | 284 | 174 | 169 | 176 | 259 | 196 | 158 | 202 | 281 | 190 | 183 | 4033 |

Reading: The rows represent the attractors and the columns represent the attracted countries. Australia is an attractor of Belgium 8 times whereas Belgium is an attractor of Australia 11 times, from 1980 to 1999.

**Table 12 Attractiveness between OECD countries 1980-1999, 'total' row and 'total' column ranked values**

| | F | GER | S | I | IRL | NL | L | B | CA | NZ | US | UK | DK | FI | GR | SP | CH | AS | P | T | J | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S** | 13 | 11 | 0 | 13 | 9 | 9 | 11 | 10 | 9 | 10 | 10 | 11 | 9 | 10 | 12 | 9 | 11 | 11 | 15 | 14 | 15 | 222 |
| **DK** | 12 | 10 | 8 | 13 | 9 | 8 | 11 | 10 | 9 | 10 | 10 | 11 | 0 | 8 | 12 | 9 | 11 | 11 | 15 | 14 | 15 | 216 |
| **NL** | 10 | 8 | 8 | 10 | 9 | 0 | 10 | 10 | 9 | 10 | 10 | 11 | 9 | 13 | 11 | 9 | 11 | 11 | 15 | 14 | 15 | 213 |
| **L** | 10 | 9 | 8 | 11 | 9 | 6 | 0 | 9 | 9 | 9 | 10 | 11 | 10 | 14 | 12 | 9 | 11 | 11 | 15 | 14 | 15 | 212 |
| **B** | 9 | 10 | 8 | 13 | 9 | 5 | 9 | 0 | 9 | 10 | 10 | 11 | 9 | 12 | 12 | 9 | 11 | 11 | 15 | 14 | 15 | 211 |
| **GER** | 8 | 0 | 8 | 13 | 9 | 4 | 10 | 7 | 9 | 10 | 10 | 11 | 10 | 10 | 12 | 9 | 11 | 11 | 15 | 14 | 15 | 206 |
| **F** | 0 | 8 | 8 | 13 | 9 | 6 | 10 | 6 | 9 | 10 | 10 | 11 | 6 | 10 | 12 | 9 | 11 | 11 | 15 | 14 | 15 | 203 |
| **I** | 6 | 7 | 8 | 0 | 9 | 7 | 8 | 9 | 8 | 9 | 10 | 12 | 10 | 9 | 12 | 10 | 11 | 11 | 15 | 14 | 15 | 200 |
| **NZ** | 6 | 7 | 8 | 6 | 9 | 10 | 8 | 9 | 11 | 0 | 10 | 10 | 10 | 9 | 7 | 14 | 11 | 11 | 15 | 14 | 15 | 200 |
| **FI** | 6 | 8 | 7 | 9 | 9 | 6 | 9 | 7 | 9 | 10 | 10 | 11 | 10 | 0 | 12 | 9 | 11 | 11 | 15 | 14 | 15 | 198 |
| **IRL** | 6 | 7 | 8 | 7 | 0 | 10 | 8 | 9 | 11 | 9 | 12 | 9 | 10 | 9 | 7 | 12 | 9 | 11 | 11 | 14 | 13 | 192 |
| **UK** | 6 | 7 | 8 | 3 | 8 | 10 | 8 | 9 | 6 | 7 | 10 | 0 | 10 | 9 | 10 | 12 | 11 | 11 | 15 | 14 | 15 | 189 |
| **SP** | 6 | 7 | 8 | 5 | 6 | 9 | 7 | 9 | 7 | 6 | 10 | 7 | 10 | 9 | 12 | 0 | 11 | 11 | 15 | 14 | 15 | 184 |
| **CA** | 6 | 7 | 8 | 5 | 6 | 10 | 8 | 9 | 0 | 5 | 10 | 8 | 10 | 9 | 8 | 9 | 10 | 11 | 14 | 14 | 15 | 182 |
| **GR** | 6 | 7 | 8 | 6 | 6 | 9 | 8 | 9 | 4 | 8 | 8 | 9 | 10 | 9 | 0 | 8 | 12 | 10 | 15 | 14 | 15 | 181 |
| **US** | 6 | 7 | 8 | 6 | 9 | 10 | 8 | 9 | 10 | 9 | 0 | 8 | 10 | 9 | 9 | 10 | 7 | 9 | 9 | 14 | 14 | 181 |
| **CH** | 6 | 7 | 8 | 6 | 6 | 10 | 8 | 9 | 9 | 9 | 7 | 8 | 10 | 9 | 7 | 10 | 0 | 9 | 11 | 14 | 15 | 178 |
| **J** | 6 | 7 | 8 | 6 | 10 | 10 | 8 | 9 | 10 | 9 | 8 | 8 | 10 | 9 | 7 | 10 | 8 | 8 | 6 | 14 | 0 | 171 |
| **P** | 6 | 7 | 8 | 6 | 6 | 10 | 8 | 9 | 9 | 9 | 4 | 8 | 10 | 9 | 7 | 10 | 8 | 7 | 0 | 14 | 14 | 169 |
| **AS** | 6 | 7 | 7 | 5 | 7 | 10 | 9 | 8 | 8 | 8 | 5 | 7 | 9 | 8 | 6 | 9 | 8 | 0 | 9 | 15 | 14 | 165 |
| **T** | 6 | 7 | 8 | 6 | 10 | 10 | 8 | 9 | 10 | 9 | 9 | 8 | 10 | 9 | 7 | 10 | 8 | 8 | 4 | 0 | 4 | 160 |
| **Total** | 146 | 155 | 158 | 162 | 164 | 169 | 174 | 175 | 175 | 176 | 183 | 190 | 192 | 193 | 194 | 196 | 202 | 205 | 259 | 281 | 284 | 4033 |

Reading: Table 13 contains the same information as the Table 11. Data have been ranked according to the decreasing total value in rows (decreasing attractors frequency), and increasing values of columns (increasing attracted by other countries)..

We start by the calculation of the two-country attractiveness between two successive years, for instance between 1980 and 1981 (Table 10). This table contains Boolean values and is built such as the rows represent the attractor countries and the columns the attracted countries. From Table 10 we have selected one country, Australia, the countries which attract it (first column in Table 10) and the countries which are attracted by it (first row in Table 10). The result is summarised in Table 13.

**Table 13 Attractiveness between Australia and other countries, between 1980 and 1981**

| | AS | J | CH | P | T |
|---|---|---|---|---|---|
| AS | 0 | **1** | **1** | 0 | **1** |
| J | **1** | | | | |
| CH | 0 | | | | |
| P | 1 | | | | |
| T | **1** | | | | |

According to Table 13, Australia attracts Japan, Switzerland and Turkey and Australia is attracted by Japan, Portugal and Turkey. We compare the consistency of the values of this table with the convergence values provided by Table 7 which represent the pair convergences between 1980 and 1981. These values '1' from Table 7 can be read in Table 13; they are in bold type. Therefore we note the consistency between the values and the result is as follows:

- there is a reciprocal attractiveness which automatically entails a convergence between Australia and the other countries (symmetric position of the '1',
- Portugal is an attractor of Australia and is not attracted by Australia, without convergence between them,
- Switzerland and Australia converge but according to an unilateral attractiveness: Switzerland is attracted by Australia without a reciprocal effect.

The repetition of the calculation between two successive years leads to build 19 similar tables of Boolean values. They are summed up in a synthetic Table 11 which provides the frequency of attractiveness between the pairs of countries over the period 1980 - 1999.

3-2 Preliminary results

Tables 11 and 12 provide the results of the calculation. Table 11 on attractiveness is different from Table 8 on the frequency of pair convergences because the new matrix is not symmetrical. In this Table 11, the countries which are attracted by other countries are represented in rows and the countries which are attractors are represented in columns. We immediately see that there is not a symmetry: for instance Australia attracts Belgium 8 times whereas Belgium attracts Australia 11 times. The total rows and columns provide the total of attracted situation (last column) and attractiveness situation (last row). From Table 11 we have built a second table, Table 12, which contains the same data but according to a double ranking, according to increasing total values of attracted situation (increasing values of the last column) and decreasing total values.

We immediately see the negative relation between the two 'attracted' and 'attractor' variables. This relation has been established in Figure 6. The x-axe represents the number of times a country is globally attracted by other countries and the y-axe represents the number of

times a country is an attractor of other countries. Turkey, Japan and Portugal are often the countries attracted by other countries and are in a process of catch up towards the countries which possess more developed social welfare systems.

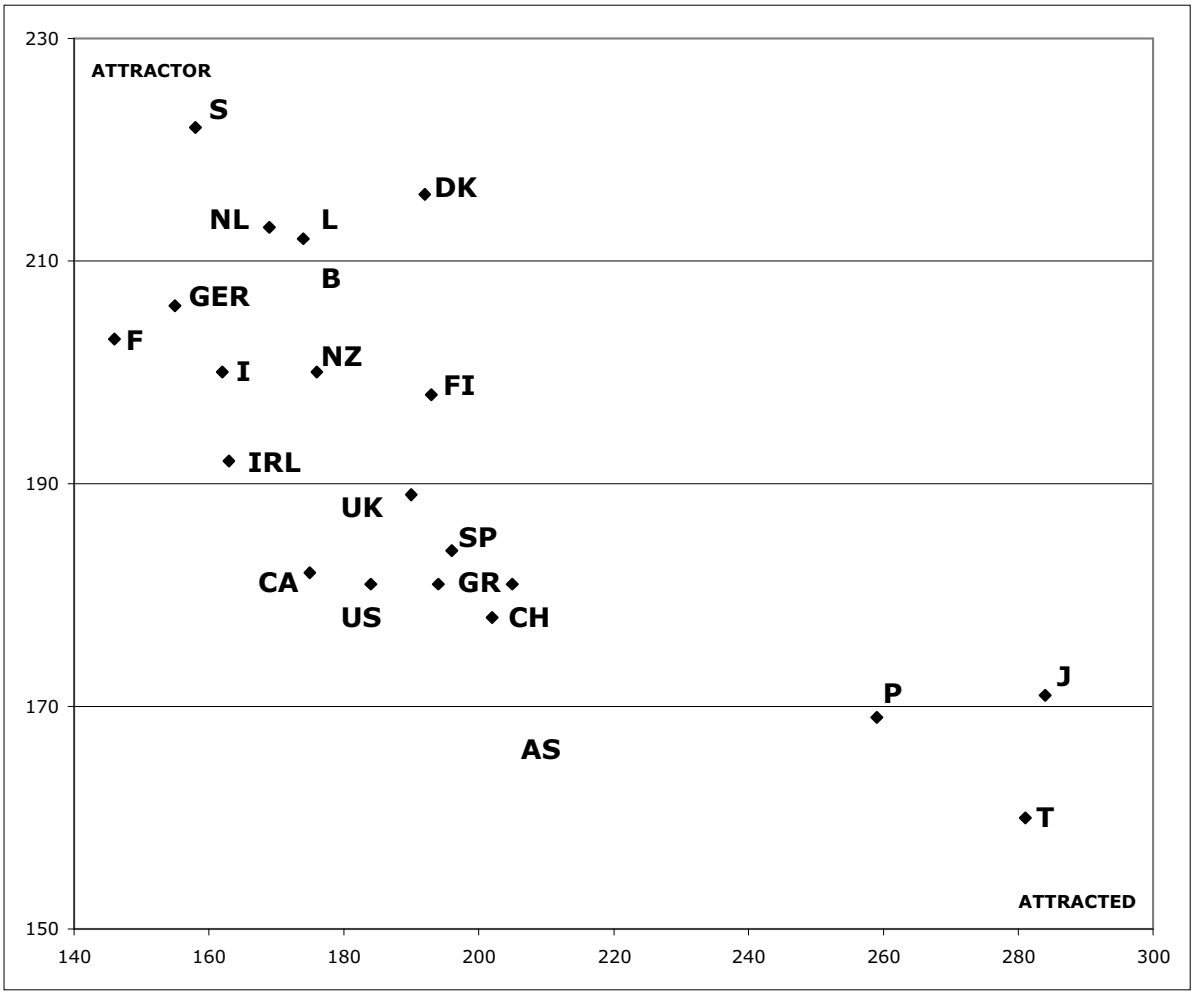
Among the attractors, the winner is:

SWEDEN

The Netherlands, Luxemburg and Belgium are also among the highest attractors. Denmark is a high attractor but simultaneously experiences some attractiveness from other countries. France is the least attracted country with a rather high attractor effect for other countries.

Table 12 provides further information on the pairs of countries which are both the most attracted and attractors. The last two rows of the table show that Turkey and Japan are in a process of catch up towards the countries which possess more developed social welfare systems.

**Figure 6 Attractiveness of OECD countries between 1980 and 1999**




## Conclusion

This paper has been inspired by some drawbacks of the most common instruments of convergence measurement and their meanings. We have focused our analysis on one type of measurement: the dispersion of values (percentage of social expenditure in GDP) between

countries (σ-convergence). The traditional tools of convergence measurement are based on a comparison between the values of each country and the mean of the distribution. This comparison is not totally consistent because the mean of the distribution is a statistical characteristic without a clear relation to a European objective.

Rather than comparing the values of countries to the mean, it would be better to compare each country to the other ones, which leads to use a Gini approach of dispersion. This approach shows that convergence/divergence is the result of a compensation between the sum of gross convergence and the sum of gross divergence between pair-countries. By this way it is possible to measure the weight of each country and to identify the frequency and the dates of each country in the process of convergence,

Despite this improvement, these instruments of measurement do not take into account one important dimension of convergence: the attractiveness between countries. The difference between convergence and attractiveness is that the first one is a symmetric relation between pairs of countries, whereas the second is often an asymmetric one. Then, we have proposed a simple descriptive method for identifying the countries which are often attractors and the countries which are more frequently attracted ones. We have applied the method on one variable, the percentage of social expenditure in GDP. The most striking result is that the downard convergence which was frequent analyses of the social reforms in the nineties, is not confirmed by this first exploratory analysis.

It is obvious that this conclusion needs many other tests on different types of variables which represent the long-term trends in social welfare systems.

## Annexes

### Annex 1 Properties of variance

Suppose one variable *x* at time t and its values for *n* countries.

The traditional analysis of the σ-convergence is based on the following process:

Step 1: We define a distance of the variable between each country i and a central characteristic of the distribution, for instance the mean $\bar{x}$.

The most common indexes which are used are the variance or the standard deviation which are built on the following distance:

$$d_{i\bar{x}t} = \left(x_{it} - \bar{x}_t\right)^2$$

Step 2: Aggregation of the distances at time t: we calculate the index of inequality between the *n* countries at time t, generally the standard deviation:

$$\sigma_t = \frac{1}{n}\sqrt{\sum_{i=1}^{n}\left(x_{it} - \bar{x}_t\right)^2}$$

Step 3: The convergence is defined as the negative variation of the index over a period [t, t']. There is a convergence between n countries if and only if: $\sigma_{t'} < \sigma_t$ .

Comparison to one country.

Rather than to choose the distance between the value of a country i and the mean $\bar{x}_t$, we may select one country as a model or a reference. Suppose we use the values of one country A which is supposed to be a model to the other countries, always the same country whatever the dates t. At time *t*, the value of the variable in the country A is $x_{At}$. The formula of the 'country-variance' $V_{At}$ is:

$$V_{At} = \frac{1}{n}\sum_{i=1}^{n}\left(x_{it} - x_{At}\right)^2$$

The country-variance becomes:

$$V_{At} = \frac{1}{n}\sum_{i=1}^{n}\left(x_{it} - \bar{x}_t\right)^2 + \left(x_{At} - \bar{x}_t\right)^2$$

$$V_{At} = V_{\bar{x}t} + \left(x_{At} - \bar{x}_t\right)^2$$

The variance measurement $V_{At}$ from one country A is always higher than the variance calculated from the mean $\bar{x}_t$, except when $x_{At} = \bar{x}_t$. From this formula we see that the convergence towards a country A depends on two components: the variation of the variance from the mean and the variation of the distance between the value of the country A and the mean $\bar{x}$. The Figure 2 illustrates this general property of the variance.

Generalisation of the comparison between countries.

Suppose that we aggregate all the country-variances between countries j (j = 1 to n):

$$\sum_{j=1}^{n} V_{jt} = \sum_{j=1}^{n} V_{\bar{x}t} + \sum_{j=1}^{n}\left(x_{jt} - \bar{x}_t\right)^2 = 2nV_{\bar{x}t}$$

This means that the comparison between all the pairs of countries i and j leads to the same result as the analysis of the traditional variance around the mean.

**Annex 2 The Gini approach**

2-1 Measurement of convergence

Suppose the variable x at the time t and its values between *n* countries.

The relation of convergence **C** between two countries i and j , i **C** j, is defined by a decrease in the distance d between the two countries i and j over the period [t, t'], that is:

$$\mathrm{d}(x_{it'}, x_{jt'}) < \mathrm{d}(x_{it}, x_{jt})$$

The traditional way of the σ-convergence consists in the aggregation of the distances at each dates t and t' and to compare the values of the aggregated distances.

The aggregated distances between *n* countries at the date t are defined by a distance:

$$D_t = D\left[\mathrm{d}(x_{it}, x_{jt})\right] = D(d_{ijt})$$

In the paper we adopt two presentations of the aggregated distances, the standard deviation in the Figure 1 and 2, and the Gini or the mean difference in the other ones:

The Gini coefficient or the mean difference is based on the metrics:

$$\mathrm{d}(x_{it}, x_{jt}) = \left| x_{it} - x_{jt} \right|$$

and D is the sum of absolute differences between all the pairs of values of *x*

$$D_t = \sum_{i=1}^{n} \sum_{j=1}^{n} \left| x_{it} - x_{jt} \right|$$

The mean difference at the date t is $D_t / n^2$. However, we do not need this division in the analysis of convergence because the number of countries remains always constant. The analysis is based on the evaluation of the sum of differences.

According to the Gini approach, the convergence of *x* between the dates t and t', i.e. over the period [t, t'] is measured by the variation $\Delta_t^{t'}$ of the distances D:

$$\Delta_t^{t'} = D_{t'} - D_t = \sum_{i=1}^{n} \sum_{j=1}^{n} \left| x_{it'} - x_{jt'} \right| - \sum_{i=1}^{n} \sum_{j=1}^{n} \left| x_{it} - x_{jt} \right|$$

The convergence of *x* over the period means that:

$$\Delta_t^{t'} = D_{t'} - D_t < 0$$

There is also a simple relation between the annual variations and the variation over a longer period [0, T]. The annual variations $\Delta_t^{t+1}$ are:

$$\Delta_t^{t+1} = D_{t+1} - D_t$$

and the variations over the period (0, T):

$$\Delta_0^T = D_T - D_0 = \sum_{t=0}^{T-1} (D_{t+1} - D_t) = \sum_{t=0}^{T-1} \Delta_t^{t+1}$$

This formula provides the relation between the annual indexes of convergence/divergence and the index of convergence over a period [0, T]. There is a convergence over a period [0, T] iif: $\Delta_0^T < 0$.

2-2 Gross convergence and net convergence of countries

It is possible to identify the countries which converge the most and the countries which diverge, and to distinguish the gross convergence from the net convergence. The variation $\Delta_0^T$, positive or negative, is a net variation of two contradictory trends, the convergence between some countries and the divergence between other ones.

We define the annual variation $\delta_{ij,t}^{t+1}$ of the distances between two countries i and j, between two successive years t and t+1:

$$\delta_{ij,t}^{t+1} = \mathrm{d}(x_{it+1}, x_{jt+1}) - \mathrm{d}(x_{it}, x_{jt})$$

This value is positive (divergence), zero (stability) or negative (convergence). When $\delta_{ij,t}^{t+1} < 0$, this means that there is a convergence between the countries i and j, between the years t and t+1.

In the Gini approach, the variation of the distances between two countries i and j is defined as follows:

$$\delta_{ij,t}^{t=1} = \left|x_{i,t+1} - x_{j,t+1}\right| - \left|x_{it} - x_{jt}\right|$$

The general evolution $\Delta_t^{t+1}$ of n countries between two successive years is:

$$\Delta_t^{t=1} = \sum_{i=1}^{n} \sum_{j=1}^{n} \delta_{ij,t}^{t+1}$$

$\Delta_t^{t=1}$ contains two groups of variations. The first one gathers the negative variations ($\delta_{ij,t}^{t+1} < 0$) which define the gross convergence $\Delta_{gc,t}^{t+1}$ between all pairs of countries i and j:

$$\Delta_{gc,t}^{t+1} = \sum_{i=1}^{n} \sum_{j=1}^{n} (\delta_{ij,t}^{t+1})_{<0}$$

In the same way we define the gross divergence $\Delta_{gd,t}^{t+1}$ as the sum of the positive variations between pairs of countries i and j:

$$\Delta_{gd,t}^{t+1} = \sum_{i=1}^{n} \sum_{j=1}^{n} (\delta_{ij,t}^{t+1})_{\geq 0}$$

This means that the net variation equals:

$$\Delta_t^{t+1} = \sum_{i=1}^{n} \sum_{j=1}^{n} \delta_{ij,t}^{t+1} = \sum_{i=1}^{n} \sum_{j=1}^{n} (\delta_{ij,t}^{t+1})_{<0} + \sum_{i=1}^{n} \sum_{j=1}^{n} (\delta_{ij,t}^{t+1})_{\geq 0}$$

$$\Delta_t^{t+1} = \Delta_{gc,t}^{t+1} + \Delta_{gd,t}^{t+1}$$

Over the period [0, T], we obtain the same type of relations. The convergence/divergence evolution between two countries i and j is:

$$\delta_{ij,0}^{T} = \sum_{t=0}^{T-1} \delta_{ij,t}^{t+1} = \sum_{t=0}^{T-1} (\delta_{ij,t}^{t+1})_{<0} + \sum_{t=0}^{T-1} (\delta_{ij,t}^{t+1})_{\geq 0}$$

The general variation of convergence/divergence is:

$$\Delta_0^T = \Delta_{gc,0}^T + \Delta_{gd,0}^T$$

Net convergence/divergence = Gross convergent component + Gross non-convergent component

The absolute contribution of one country i to the convergence over the period [0, T] is defined as:

$$\delta_{gc,i} = \sum_{j=1}^{n} (\delta_{ij,0}^{T})_{<0}$$

It is the sum of all the negative variations between one country i and all the other ones.

The absolute contribution of one country i to divergence or stability is:

$$\delta_{gd,i} = \sum_{j=1}^{n} (\delta_{ij,0}^{T})_{\geq 0}$$

It is the sum of all the positive variations between one country i and all the other ones.

The following formula shows the relation between the gross convergence, the gross divergence and the net convergence/divergence.

$$\Delta_0^T = \sum_{i=1}^{n} \delta_{gc,i} + \sum_{i=1}^{n} \delta_{gd,i}$$

**Annex 3 Attractiveness**

The relation of convergence **C** between two countries is a relation of equivalence because it is characterised by reflexivity (i **C** i), transitivity (if i **C** j and j **C** i , then i **C** i ), and symmetry (if i **C** j, then j **C** i). Consequently, the distance between two countries is defined by a symmetry $\mathrm{d}(x_{it}, x_{jt}) = \mathrm{d}(x_{jt}, x_{it})$ and provides the symmetric matrix in the table 5.

One drawback of the relation of convergence is that we do not know whether one country is attracted by another one or not. The relation of attractiveness is different because we suppose that we have a leader and a follower. The idea of attractiveness is based on a new relation **A**, such as i **A** j means that the country i 'attracts' j, or i is an attractor of j, or j is attracted by i.. The difference to the convergence is that **A** is not a symmetric relation. If i **A** j, it does not automatically imply j **A** i.

A country i is defined as an attractor when the values of the variable in the country j at the date t' (t' > t) become closer to the values of the variable in the country i at the date t, that is:

$$\mathrm{d}(x_{it}, x_{jt'}) < \mathrm{d}(x_{it}, x_{jt})$$

We say that the country i attracts j. When i **A** j, we define a Boolean variable such as:

$a_{ij,t}^{t'} = 1$ iif i attracts j and $a_{ij,t}^{t'} = 0$ when i does not attract j.

We obtain four types of attractiveness relations:

1- $\mathrm{d}(x_{it}, x_{jt'}) < \mathrm{d}(x_{it}, x_{jt})$ and $\mathrm{d}(x_{it}, x_{jt'}) \geq \mathrm{d}(x_{it}, x_{jt})$; $a_{ij,t}^{t'} = 1$ and $a_{ji,t}^{t'} = 0$

In this case, the country i is an attractor and the country j is not an attractor of i.

2- $\mathrm{d}(x_{it'}, x_{jt}) < \mathrm{d}(x_{it}, x_{jt})$ and $\mathrm{d}(x_{it}, x_{jt'}) \geq \mathrm{d}(x_{it}, x_{jt})$; $a_{ji,t}^{t'} = 1$ and $a_{ij,t}^{t'} = 0$

In this case, the country j is the attractor of i and i is not an attractor of j.

These two cases are define an unilateral attractiveness of one country i or j and are compatible with a convergent or a divergent trend between t and t'.

3- $\mathrm{d}(x_{it}, x_{jt'}) < \mathrm{d}(x_{it}, x_{jt})$ and $\mathrm{d}(x_{it'}, x_{jt}) < \mathrm{d}(x_{it}, x_{jt})$; $a_{ij,t}^{t'} = 1$ and $a_{ji,t}^{t'} = 1$

In this case, the country i and the country j are both attractors. They define a reciprocal attraction. Therefore this case supposes a convergent trend between i and j..

4- $d(x_{it}, x_{jt'}) \geq d(x_{it}, x_{jt})$ and $d(x_{it'}, x_{jt}) \geq d(x_{it}, x_{jt})$; $a_{ij,t}^{t'} = 0$ and $a_{ji,t}^{t'} = 0$

Therefore, the countries i and j are both in a divergent process. In this case the convergence is impossible.

Figure 5 presents a convergent process but with only one country (B) which is an attractor.

Table 10 is a Boolean matrix which contains the values $a_{ij,t}^{t+1}$ between two successive years (1980 and 1981). The attractors are in columns and the attracted countries in the rows of the table. We see that this matrix is not symmetric.

Over the period [0, T], we obtain T Boolean matrices and we measure the attractiveness the frequency of $a_{ij,t}^{t+1}$ in a new matrix, such as:

$$A_{ij,0}^{T} = \sum_{t=0}^{T-1} a_{ij,t}^{t+1}.$$

The Tables 12 and 13, and the Figure 6 provide the results of the analysis of 21 OECD countries from 1980 to 1999.

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